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Methods of Teaching Biology to Blind Students With the Seeing

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Modern 1950 educational philosophy now decrees that, "The blind shall no longer be set apart in school and society, but become an integral part of it." Many city and suburban high schools are now adapting their curricular and teaching facilities to include the blind and sight handicapped; who, after having completed their primary training at resident schools for the blind, are being farmed out to regular high schools for the completion of their education. The social sciences, English, and other languages present a few problems of methodology and special techniques for adaption to blind student comprehension. The challenge comes in the sciences.

In the course of teaching biology and other sciences to the students of the Baltimore City College, the writer has been faced at different periods with the fascinating problem of how to present a subject in which the visual aids are such a dominating factor to the blind students who have come to him from time to time with regular classes. At least one-half of the work in biology is done in the laboratory, and quite a fair percentage of laboratory work calls for considerable vision: for instance, making drawings of various biological specimens with or without the aid of a microscope, dissecting plant and animal forms and reproducing them in drawings in the laboratory notebook. It is readily seen that, under such conditions, the blind student not only suffers from a handicap in trying to complete his work, but spends much time in the laboratory doing little or nothing. It is, however, my feeling that the infinite wonders of nature should be revealed to the blind student through specialized work in biology, so that his contacts with the outside world become more interesting. His interests should be developed along biological lines and his every means of perception trained to appreciate these marvels of living matter. If the blind student is to enjoy and appreciate his work in the subject, special attention

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must be given to projects, problems, and methods adapted to his needs.

The aims of biology as applied to the blind students include the following:

1. To teach him appreciation of nature by the aid of his senses of touch, taste, smell, and hearing.

2. To present plant and animal forms tactually and through reproduction in clay.

3. To present microscope topics by means of clay models made by the teacher or by the blind student himself.

4. To specialize in the laboratory in morphological biology, including an intimate study of skeletal forms.

5. To offer some vocational possibilities in biological sciences to the visually handicapped student. (For example, one former student got his inspiration to study osteopathy; another, physio and hydrotherapy; still another, due to his interest which he first gained through work in biology, specialized in scientific massage.)

6. To develop the powers of speech, personality, and confidence in public address by calling upon blind students frequently for oral reports and recitations in the classroom. They may, for example, act as officers or take charge of recitations, and so develop leadership, ability to teach, and worthy vocational aims.

7. To give special attention to the students' recognition of trees, plants, fruits, flowers etc. using campus facilities wherever possible. They can collect specimens, run their hands over buds and the bark of trees, and learn to recognize through the sense of smell any flowers or plants that give off characteristic odors.

8. To give them practical work with growing things. Blind students may be permitted to grow some of their own plants in germination bins, where they can keep them under observation from day to day. The principles of food preservation and canning can be taught by letting them raise bread and fruit molds on stale bread and fruits; by smelling and feeling, they can identify some of the common growths.

9. To help create a love of nature and of living things which will add interest to their more or less circumscribed lives. The hobby aim may be motivated through insect, butterfly, leaf, flower, or animal collections, etc., incentives which will keep them pleasantly occupied in the fresh air.

The first laboratory exercise, after a preliminary demonstration of a few elements of chemistry, was a microscopic study of the cell. The cell, which is the basis of life, is obviously very important; but it is a problem to present the morphology to a blind student, particularly as the other students may be getting their first introduction to the cell visually by means of the microscope. The answer to this problem is a clay or plaster model. The teacher, or possibly an art student, can make an outline of the cell in clay to be passed to the blind students so that they may feel the parts while the instructor is lecturing on them. When the class makes a drawing of a cell the blind students, with the aid of a bright seeing student, reconstruct the cell by making a cardboard cut out or clay model Braille labeled.

The next three months' work was devoted to botany, and the routine laboratory work included macroscopic and microscopic studies of all parts of the plant, with demonstrations of physiological activities wherever possible. This work came in the fall, when plenty of botanical material was available. All the students in the class, including the blind, were asked to bring to the laboratory any specimens they might have gathered over the week-end, thus relating the subject to nature. To encourage this, the students were given credit for bringing in valuable plant material which could be used by the class. To my surprise, the

blind students succeeded in getting the most specimens!

Whenever the class as a whole used the microscope to study microscopic anatomy of the parts of a plant, the blind boys secured their practical demonstrations with various models; but in addition they were given as many actual specimens as possible for macroscopic study. While the seeing students studied roots under the microscope, the blind students were given as many kinds of roots to handle as we could secure. When we studied leaves, we had a leaf collection containing specimen leaves of every tree on our campus, and the blind boys were able to identify many of them. The blind students dissected their own seeds, the dissections being made with their fingers and finger-nails. They also germinated them by themselves. They dissected buds and large simple flowers as did the students with sight, naming and describing the parts afterwards. The stem study, of course, was easy, as they simply collected longitudinal and cross-section stems for their personal use, using clay models to demonstrate microscopic anatomy with labelling in Braille.

When we took up forestry, these blind students were asked to make special reports orally on any plant or tree in which they were interested. This helped to give them confidence in speaking in public. The other students in the class, appreciative of the blind students' handicap, gave the most courteous attention possible, which in itself stimulated confidence in speech. Socialized recitations were given, with the blind boys taking full charge of the class for the entire period. Nothing seemed to give them more confidence than this assumption of responsibility. They conducted the classes perfectly, and the other students responded to their questions in such a way as to give live-wire participation. The students take full charge of the class, the teacher being merely an interested, but quiescent, observer. Having one or two of these lessons a month with the blind students in charge does a great deal to overcome the inferiority complexes under which the blind student labors, because, if one can gauge by facial expression, they get the keenest pleasure possible out of this supervisory capacity which they assume when in charge of the class; and their fellow-students appreciate their efforts.

The study of yeasts, dust, molds, especially those which have antibiotic action, mushrooms, and bracket and shell fungi presents several problems that are very hard to overcome in the laboratory because so much of this work is microscopic. Here again a clay or cut out model was used to take the place of the microscope; and, with the blind students, we had to specialize in their perception of the larger non-chlorophyllic plants, such as mushrooms, puff-balls, and the bracket and shell fungi. The antibiotics, such as penicillin, streptomycin, and aureomycin, can be demonstrated with models of the molds and actinomycetes, and their role in destroying disease-inciting (pathogenic) bacteria can be explained. When it was possible to obtain any material for them in this phase of the work, a bright sighted student read this matter of special interest on the topics studied from some good nature book.

I have always been pleased to observe that there is the keenest kind of competition among the seeing students for the privilege of instructing and teaching the blind students. Whenever laboratory work was given, each blind student had beside him a student who had made a special preparation of the lesson and was in a position, with the use of text and laboratory notebooks, to give his companion worth-while instruction. These student instructors were accelerated members of the class and had had

some student teaching experience. They perfected their own technique by having to make demonstrations applicable to the requirements of the blind students. It benefited both. The topics included, of course, the algae, an entirely microscopic study which had to be taught to the blind students by means of models and by special readings and lectures calculated to interest them in this basic group of living plants. The mosses and ferns were taught by having the blind students use actual specimens; they were, intentionally given the largest specimens possible. The alternation of generations which takes place in these plants and also in the seaweed, can only be taught by reading, recitations, and, again, clay models wherever it is necessary to convey the morphological characteristics. The students were given as many kinds of living plant forms relating to the lesson as could be secured for them to study tactually. The blind students were then given the problem of working out the parts in the mosses or ferns by making little models of each phase of the reproductive process.

In the zoological units of the work in biology, which consumes about three months, the blind students had opportunities to use the touch senses to advantage. This part of the work covered the animal kingdom from the minute protozoa to the mammals and included the study of live and preserved specimens of each phylum of the animal kingdom. In the study of protozoa, the minute animal forms present in stagnant water are always facinating to all students except those suffering from the impediment of blindness. It is hard for the blind student to conceive of the myriad wonders of life in a drop of water when he is unable to see them. To compensate for this, I secured a popular nature-study book; and the students who had previously passed their work on protozoa read interesting articles about protozoan life and then quizzed the blind students on them. Again, the tactual models were a means of perception. The class as a whole was then called upon to report on protozoan diseases, such as malarial fever, sleeping sickness, and amebic dysentery; and the blind students worked out the life cycle of the *Plasmodium malariae*, which they presented to the class orally. It has been my observation that the interest of blind students is always heightened when they are given some special assignments to demonstrate or to present to the class.

The sponges were dismissed with readings and actual feeling of them by the blind students; the same applied to the jelly-fish. The corals were especially interesting to them. I endeavored to secure as many types of coral as possible, and the blind students took a great interest in them because they could feel the coral imprint and note the concentric formation of the coralite.

The starfish, of course, is ideally adapted for external study by blind students and presents no problems at all except where dissection is attempted, in which case thoroughly hardened specimens which have been practically dried out must be used for the blind students. Sea-lilies, brittle-staves, basket-staves, sand-dollars, sea-urchins, and sea-cucumbers were given to them for actual manipulation and touch study after which, examples of each were lined up, and the blind boys identified them and picked out special distinguishing features. The tube feet, ambulacral system, and, particularly, the Aristotle's lantern in the sea-urchin proved excellent material for study. Morphological wonders of nature can be taught easily to blind students, and animals such as these meet their requirements.

The class as a whole was next given the study of the worms, including parasi-

tic worms and the earthworm. Again, socialized recitations and special reports on parasitic worms were used to advantage; and the blind students were either given charge of a lesson, or at least were called upon to present reports on the tapeworm, hookworm, (liver-fluke) or whatever parasite they might have been interested in.

The blind students were gradually accustomed to handling clammy, unpleasant material by being asked to feel a tapeworm, a leech, and a liver-fluke. They seemed quite sensitive at first and had to be dealt with carefully at this stage so that they would not be nauseated by their contact with material that is frequently unpleasant even to those in possession of their sight. One blind student could not be persuaded to touch the material, so the teacher laid his own hand on the worm, then passed the worm through his hand and fingers; and the student, just to demonstrate that he was as good as the rest of them, refused to cringe. From then on, he was not afraid to handle anything. In fact, just like a medical student, he held a dissected animal in one hand and a ham sandwich in the other.

The laboratory assistant and one other student were able to teach the blind boys how to dissect a worm, making a long incision from the mouth to the anal opening with scissors. The trained sense of touch of the blind students enabled them to make more accurate dissections than average seeing students. The procedure was as follows: One blind student held the worm while the other passed scissors through the mouth, cutting upwards and backwards and making a long incision from end to end. The internal organs of the earthworm were then taken out, the blind students used their fingers to locate the larger organs and structures. They passed the same examination as the seeing students at the end of this dissection work.

Insect study proved intensely interesting to the blind students. They made special readings from insect books, read stories of the miracles of insect life, particularly of the colonial, agricultural, and warrior ants, and presented these to the class in the form of oral reports. They were required to handle and to know as many interesting features of the external anatomy of the insect specimens as the instructor was able to secure, which kept them fairly well occupied in the laboratory. A very large lubber-locust was given an external dissection by the blind students in which all the parts were laid out in a row, just like soldiers, and every part named. Another demonstration made by a good seeing student was one in which all the dissected parts of the external anatomy of a locust were pasted on a board. The blind students learned their features by running their fingers over them.

Of course, in the study of crayfish and the lobster, the blind students had an opportunity over the rest of the class in their anatomical understanding of the animal. A lobster was dissected by a good student and all the parts were glued onto or tied onto a board. When this was completed, the blind students gathered around the board and went over them with the air of student instructors until they knew every part. Crabs, horseshoe crabs, crayfish and a hermit-crab were given them for special study. Live crayfish were particularly interesting. The blind students were given a project to determine: (a) The methods of locomotion, both terrestial and aquatic; (b) the use of the crayfish antennae; (c) the way in which a female aerates her eggs; (d) the way in which the swimmerets function in swimming and in egg protection. This project was carried out in a small aquarium.

A similar project was undertaken using live pond and land snails. In the study of the shell-fish, again, the blind students had many opportunities to enjoy work with the different types of shells from shell-fish fossils that the instructor secured. These were laid out for tactual observation and identification.

The blind were given a large clam, which they dissected themselves except for cutting the two muscles which held the shell shut. They were able to learn most of the internal organs and structures very well. They were given an opened sea-squid to study internally, using their fingers to locate the structures of interest and the important organs.

These students were so used to handling animal material by this time that they did not flinch when a pickled octopus was put into their hands. Instead they handled it like zoological veterans.

The vertebrates necessarily presented the ideal work; for with these blind students were able to comprehend every particular. They read from Braille books, or had read to them some interesting true stories of shark and fish habits, and presented these to the class. They did not hesitate to put their hands right into the abdominal cavity of a large fish and feel all the organs; and in the study of the bones of a fish, they were, of course, in their element. The instructor here secured as many skeletal forms of fish, frogs, and birds as possible, using the human skeleton in addition, in order to give them the aid of student instructors and a laboratory assistant, special work in comparative osteology. They were required to learn the name, shape, position, and function of each important bone in the bodies of these animals.

I had in mind particularly the fact that these students might make use of this knowledge basically in some such work as scientific massage, osteopathy, or any of the forms of modern mechanotherapy or hydrotherapy, phases of the medical art that a blind student can successfully practice. When this idea was presented to them, they naturally took a great deal of interest because they saw possibilities of future vocational endeavor in this kind of work.

The blind students dissected their own frogs and learned all the internal organs. But in order to give them a fair chance, the instructor secured the largest bull frogs for their use. Reptile, bird, and mammal study was accomplished in the same way, the blind students being given as many specimens as we were able to obtain for their use. To vitalize mammalian study, one of the students took special interest in raising white mice and guinea pigs and told me he got a fair price for them by selling them to the medical school laboratories.

The course culminated in the study of human physiology and hygiene, and included two weeks' work in first aid sponsored by the American Red Cross. Here the blind students specialized in the anatomy of the human skeleton and were required to know the location, shape, and use of all the important bones in the body. The parts of the skeleton were disarticulated, and the blind were given the project of putting the skeleton together again. They had absolutely no trouble doing this.

We had debates on heredity versus environment and vivisection etc., in which the blind students were expected to participate fully. They were supplied with reading material in this type of lesson in order to bring out their argumentative and impromptu speech abilities. Finally, the students in the first aid class worked in groups, the blind students form a group by themselves with a Boy Scout or Red Cross graduate in charge. They went through all the procedures, including bandaging, splint

dressings, artificial respiration, tourniquet application, and the various kinds of life-saving procedures that are required for the Senior American Red Cross Certificate.

It would appear that this work in first aid would present too many obstacles to make it a valuable service and form of instruction to these blind pupils. But here, the instructor received a surprise. The blind students, with one exception, were able to do all of the first aid work as well as any of the other members of the class. Difficult problems and projects, such as putting on splints for the various fractures and dislocations and the different types of bandaging, using tourniquet, roller, and triangular bandages, were accomplished easily by these visually handicapped students. In the demonstration of artificial respiration and of the various carries, such as the fireman's carry, armchair, and lifts, the blind students were able to perform these difficult tasks just as readily as if not more so than the average seeing student. The best demonstration of the Schaefer method of artificial respiration was given by a blind student. They were able to carry out the necessary life-saving measures required for the Boy Scout merit badge or the Senior Red Cross First Aid Certificate, and did them just as promptly and efficiently as the other students. Their interest in this work and their adaptability in co-ordinating mind and muscle in all phases of the practical work illustrated beautifully how the physiological laws of compensation tend to function. Ordinary students frequently have difficulty in learning some of the types of bandaging, splint dressings, and, particularly, the co-ordination required in efficiently performing the lifts and carries. Here the blind students appeared to have advantage because they concentrated and relied upon their own senses to direct their efforts.

I tried to make use of every method of teaching in order to sustain the interest of the blind students. Variety is the spice of life for the blind just as truly as for students with sight. When every type of teaching technique is utilized, the students do not get tired of their work. The methods of teaching used for blind students should include the socialized recitation, the project and problem method, formal lecture recitations and oral reports, specially adapted demonstrations, debates, dissection by students, collection of specimens in field work, and special reading assignments. I thought the blind students would be unavoidably limited when the silent science moving pictures were being shown in the classroom, but even there they were not seriously handicapped, for a good seeing student sat with them while the movies were being shown, read the titles, told them what he saw; and they enjoyed it just as much as the students who were able to see. Blind students tell me that they frequently go to the "talkies" just to hear the conversation, or if the film is a silent one, they still go, provided they have somebody to read and describe for them what is going on. The blind students enjoy biological and science television shows if the narration is good.

Success in teaching the blind will not be determined by what the teacher is able to do, but by what the blind student is able to learn and by what actual work he is able to perform in spite of the fact that one of his principal senses is lacking. In other words, the blind student should be "the doer of the act" all the way through his course in biology and nature study.

America's Conservation Pledge

America's Conservation Pledge, a 30-word creed defining the term "conservation" and calling the attention of all to the necessity for preserving our remaining natural resources, is now in its third year of service to the nation. The Pledge had its origin in a national competition, with $5,000 in prizes, sponsored by *Outdoor Life* magazine in 1946. Details of the contest were carried by the national press and radio as a public service. Officials of the federal and state governments actively supported the competition by helping to publicize it in schools, among sportsman's clubs, and elsewhere.

More than 15,000 entries were received during the contest—an amazing response in view of the fact that each person who submitted a Pledge was also required to write an essay on the necessity for conservation. The selection of the winning Pledge was made by a distinguished board of public officials, conservationists, educators, and scientists. Their names follow:

David A. Aylwird, President, National Wildlife Federation
Dr. Hugh H. Bennett, Chief, U. S. Soil Conservation Service
J. Hammond Brown, Director, Outdoor Writers Association of America
Paul Clement, President, Izaak Walton League of America
Dr. Ira N. Gabrielson Director, U. S. Fish and Wildlife Service
A. C. Glassell, President, Ducks Unlimited
P. J. Hoffmaster, President, International Association of Game, Fish, and Conservation Commissioners
Karl E. Mundt, Member of Congress
Dr. Thomas T. Read, Vinton Professor of Mining Engineering, Columbia University
W. S. Rosecrans, President, American Forestry Association
F. L. Schlagle, President, National Education Association
Frederic C. Walcott, President, American Wildlife Institute
Dr. Ray O. Wyland, Director, Division of Relationships, Boy Scouts of America

The winning Pledge was written by L. L. Foreman, of Santa Fe, New Mexico. On December 7, 1946, at a public ceremony in Washington, the Conservation Pledge was presented to the nation through Secretary of the Interior Krug. Immediately thereafter, the Pledge was put to use all over the country: in schools, where its regular recital by students has often brought the first knowledge of what the word "conservation" really means and why natural resources should be preserved; among youth organizations, including groups of Scouts, Camp Fire Girls, and 4-H Clubs; by sportsman's clubs, hundreds of which have adopted the Pledge as their official doctrine; by state and federal agencies, notably the U. S. Department of Agriculture, the U. S. Department of the Interior, and the conservation departments of the various states; and by civic groups, private individuals, and business houses. Governors of a number of states proclaimed February 5, 1947, as Conservation Pledge Day. The story of the Pledge was read into the Congressional Record by Representative Mundt of South Dakota.

The Pledge has been adopted by the American Museum of Natural History. It appears in the official literature and mailings of many of the state fish and game and conservation departments. It is also used in the advertising and on the stationery of many business houses. Sportsman's clubs all over America imprint the Pledge design on their membership cards, on posters, and on their club stationery. The U. S. Forest Service has distributed hundreds of thousands of copies of the Pledge to schools, as have state conservation departments.

Conservation Pledge

**I GIVE MY
PLEDGE AS AN AMERICAN
TO SAVE AND FAITHFULLY TO
DEFEND FROM WASTE THE
NATURAL RESOURCES OF
MY COUNTRY – ITS SOIL
AND MINERALS, ITS
FORESTS, WATERS,
AND WILDLIFE**

Outdoor Life has sought the widest possible publicity for the Pledge but has never asked recognition for its part in originating and developing it. This is America's Conservation Pledge, in every respect, just as conservation is America's problem.

Polio - 1949

BETTY LOCKWOOD
National Foundation for Infantile Paralysis

Polio has been with us for a long period of time. The first identified major attack reported occurred back in 1887 in Sweden. Then from 1900 on, the disease commenced to appear in epidemic form throughout Europe. In this country, the last five years have brought an unusually high incidence, with each year bringing an increased number of patients. 1946 brought over 25,000; 1948 over 27,000, and this year of 1949 has proved highest of all—over 40,000 cases thus far, with more still being reported.

Some of this increase may be due to better diagnosis and reporting, and to better acceptance by the hospitals, for today we have 300% more hospitals in the U.S. accepting polio cases than were accepted 10 years ago! Better acceptance by the hospitals means better coverage of the disease, and therefore better diagnosis. While better diagnosis and better reporting may have been responsible for identification of more nonparalytic cases, the incidence of paralytic cases has not decreased. This is true in this country and in other areas—in Japan, the far eastern countries, South America—all areas formerly free of sudden and sporadic outbreaks, and where medical care and diagnosis are not equal to that of this country. This clearly indicates that the total incidence of the disease is rising, and not merely the recognition of it.

Let us review briefly some of the factors known at the present time about polio. Polio is caused by a virus, and has the limitations of knowledge associated with many of the virus diseases. The presence of the "germ" in the body has to be identified either by the diagnosis of the disease, or by taking a sample of excreta in which the virus is suspected, and testing that suspension in monkeys, then waiting to see if the animal succumbs to the disease. A lengthy process to aid diagnosis of the disease in a human being!

Direct tracing of the mode of spread of polio remains exceedingly difficult. What is clear is that spread occurs through *close personal contact* and not through intermediate vectors. Health authorities and medical persons no longer believe that it helps to prevent the spread of the disease to close schools and then permit children to intermingle with new groups on the streets and gatherings. An interesting factor to consider is that infantile paralysis often seems to be "choosy" in its victim, in that it picks the child that is in the pink of health, that is the picture of good nutrition.

What spreads polio? The question of the possibility of an insect vector as the primary means of transfer of the virus has been fairly well disproved. To have polio virus transferred through the medium of an insect means that it would need to be one that was common to the whole world, and to all climates and environments. It is decidedly unlikely that it would prove to be a blood sucking insect, since polio virus is not recovered from the blood stream. The mosquito was considered for a while, but epidemics break out and rage in many areas where mosquitoes are scarce or unknown.

The fly has always been under scrutiny. It certainly is the most intimate insect linked with the habits of man. It is found in every country, and found closely associated with human and animal excreta. It is found around food of all kinds. Since infected persons,

both carriers and apparent cases, excrete virus for several weeks, and the virus remains "alive" in excreta and sewage for indeterminate periods, any insect with access to excreta and food could automatically be considered very "eligible" for spread of the disease. Polio virus has been recovered from flies both in rural and urban areas, and, it has been proved that food exposed to flies during an epidemic, and then fed to chimpansees, has produced an asymptomatic polio infection. However, we have combatted flies as a "public nuisance" for many years, and yet the incidence of infantile paralysis has increased. Meanwhile dysentery, a fly-borne disease, has been reduced. Also the polio virus has never been found on flies until an epidemic is well established.

We do know definitely, however, that the important carrier is man himself. Estimates vary as to the number of persons harboring the polio virus during epidemic times without their having outward signs of clinical illness. It is thought that the ratio is about 100 to 1 of asymptomatic infection to paralytic infection. The danger lies in the "ninety and nine" who may be potential "polio Mary's" and be just as capable of spreading the disease as the recognized and labelled cases. These carriers may be the main link in the chain of spreading infection. We know also that if one member of a family contracts the disease, that it is very likely that other members of the family will harbor the virus. To isolate all these carriers would require wholesale quarantine.

One fortunate result is that these subclinical cases acquire immunity, so that over 70% of the population are usually immune to poliomyelitis by the time they are 25.

Again, as with suspected cases, identity rests on isolating the virus from the stool to use as the "test" to identify these "silent carriers".

The whole pattern of polio as a disease seems to be changing; changing in regard to—(a) *geographic distribution;* (b) *virulence;* (c) *age groups.*

During the recent World War II, an unusual incidence of polio cases was noted abroad among members of our Armed Forces. Persons who seemingly had been immune in this country, contracted the disease when stationed in other lands. Since we now know there are several strains of polio virus, and that immunity to one does not carry immunity to another, perhaps these men came up against a new strain of virus to which they succumbed. These new outflashes in the far corners of the world may be new and unwelcomed forms of the disease, *or they may be a change in the virus itself to a more virulent form.*

There is a definite change in pattern in the shift in age incidence. This shift is to higher age groups. In 1916, in the epidemic of New York, 85% of the cases were in the 0–5 age bracket. In the epidemics in Chicago and Detroit in the years of 1939–44, there were only 23% of the cases in this age group. The attack rate now in the U. S. is the highest it has ever been, and is now greatest in the 5–10 years. 25% of the cases are now over 15 years of age, or one case in every four! In more primitive countries, polio still involves the 0–5 age bracket almost exclusively.

This brings the factor of hygienic standards to be considered. There is some evidence that there are no major epidemics in countries of low hygienic standards. Where the disease thus is endemic, early exposure to the disease does not permit a large susceptible group of older children and adults to accumulate. In the U. S., we "protect" our young children and avoid contacts

for them. (Perhaps we save their exposure to polio to a later—and more dangerous—age!) Certainly, improved sanitation of hygiene in both Europe and America has not brought reduced attack rates for polio.

Since the factor of reduced exposure does not seem to have aided in lessening the incidence of polio, and the virulence of the disease seems to be on the increase, emphasis must be applied to controlled exposure. This means some form of immunization by vaccine. Last spring (1949) scientists at Johns Hopkins were responsible for successfully vaccinating monkeys against infantile paralysis. It was the first time that type specific immunity has ever been given to an animal. However, this is in too undeveloped stages to be considered safe for human vaccination.

The major problems facing research personnel today in relation to this problem evolve from the facts—or problems—connected with:

1. being able to grow enough virus, and being able to separate it from all other material, to isolate it in a test tube and produce it in quantity;
2. being able to identify each strain of polio virus—there are three major types known at this time—and to learn how they affect the body; and
3. learning a way to kill the virus. A chemical is needed that is strong enough to destroy the virus, yet not injure the body cells, or a vaccine that will render the virus harmless.

One hypothesis advanced by medical research today is that there are a number of polio viruses with different immunological properties. Also, that the strains of viruses over the world vary. Each new epidemic may be aided by the invasion of a new strain. Each strain provokes a different pattern of immunity host-response, so that a person becoming immune to one, may not be immune to another. The vast majority of persons develop a silent infection with no detectable symptoms. Symptoms may appear in 3 clinical forms of polio:

1. *Abortive:* those cases in whom polio is suspected, but no clinical diagnosis can be made. The symptoms are those of many other childhood diseases—nausea, headache, sore throat, lack of appetite.
2. *Non-paralytic:* patients develop symptoms of involvment of the central nervous system, such as stiff back and neck, but damage is slight and does not progress into muscular paralysis.
3. *Paralytic:* discernible muscular weakness lasting for two or more weeks.
   a. Bulbar
   b. Spinal

The incubation period is variable, it may be from 3 to 35 days, with ten days being the average. The period of greatest transmission of infection seems to be the period just before actual onslought of the disease and during the first week of illness. Symptoms displayed by younger children may vary from those in older children. Two stages usually appear in younger children, and the symptoms occur more abruptly. The first phase is a non-specific illness, lasting from one to two days. This is followed by seeming recovery. The second phase is the abrupt onset of the disease proper with elevated temperatures and symptoms involving the central nervous system. The person may be extremely irritable, followed by lassitude and even coma. The first phase is often missed by the family and school, since young children get stomach upsets often. Adolescents and adults often omit the first phase, and pass directly into the second phase accompanied by severe pain.

Early and enforced bed rest is very important. If strenuous activity or sudden chilling occur during the early stages—when the symptoms are perhaps unrecognized—the balance may be tipped in favor of a more virile virus attack.

Since infantile paralysis is caused by a virus, its body relationship is even more parasitic than that of bacteria.

Bacteria, for the most part, live between the cells, absorbing their nutrients from the body fluids. Viruses live *inside* the cell. To successfully kill the virus without destroying the cell itself is the major problem. Before this can be accomplished, we must know about the different strains of viruses contributing to the disease poliomyelitis.

Headway has been made recently in determining strains and types of polio viruses. One of three methods usually is employed:

1. Monkeys are vaccinated with repeated injections of intramuscular doses of one type of virus. This develops type immunity. Then test viruses are introduced. If the animals resist the new injection, the two viruses are considered to be related. If not, they are considered to belong to different immunological types.
2. Monkeys are infected via the brain with a paralytic dose of a virus type. The recovered animals are then subjected to a test virus. The results—negative or positive—indicate relationship or non-relationship.
3. The sera of recovered or vaccinated monkeys are mixed with a test virus. The mixture is then introduced into another group of animals for observation of the neutralizing effect of the serum. If no paralysis occurs, the test virus has been neutralized, and the two viruses are presumed to be related. If the animal contracts the disease, the two strains are considered unrelated.

One piece of research working along these lines has been carried on by Drs. David Bodian, Isabel Morgan, and Howard Howe of Johns Hopkins. They used the intramuscular injections, involving 14 different types of polio virus. They first used two strains which they knew were unrelated—the Lansing and the Brunhilde. By using two large groups of monkeys for each strain, then testing with other types by sub-groups, they were able to prove that of the viruses used

The Lansing strain consisted of:
- The Lansing (from Lansing, Michigan, patient in 1937)
- The Wallingford (from Los Angeles in 1934)
- The MEFl (from British Middle East Forces at Cairo in 1942)
- The MV or mixed virus (from Rockefeller Institute)

The Brunhilde strain consisted of:
- The Brunhilde (a severely paralyzing strain from Baltimore, 1939)
- The Kotter (a mild strain from an Illinois epidemic of 1942)
- The Frederick (from throat swabs in Baltimore epidemic of 1944)
- The Per (from West Virginia, 1940)
- The Riley (a stool sample from Chicago, 1943)
- The Sudeck and the Beich (stool samples from Baltimore, 1941)
- The MEF_2 (from Cario, World War II)

(The Brunhilde strain appears to be most widely occurring, since the nine types are representative of those isolated in recent years in the U. S.)

The Leon type (from Los Angeles, 1937). This proved to be immunologically incompatible to both the Lansing and Brunhilde.

This work is the most comprehensive attempt thus far to classify existing virus strains. Because of the tremendous importance of this type of research, the National Foundation granted over a million dollars to four university centers this past summer (1949)—Southern California, Utah, Kansas and Pittsburgh. This brings the total amount expended for research to nearly eleven million dollars to date.

Another recent piece of research reported on this fall, at meetings of the American Public Health Association, by Dr. William Hammon, University of California, seemed to point the way to the conclusion that polio infection is less rapid in higher economic groups. His data was taken from outbreaks of infantile paralysis in California, Mexico, Japan and the Philippines. Three factors seeming to have an affect on incidence of the disease are: 1) the climate; 2) the economic status; 3) sanitation. His study showed that family incidence

rose as economic status fell. He doubted though that this was true in the United States, where better reporting is possible. His serum surveys showed that incidence was higher in the colored race in more primitive societies, and the further south one went. The higher family incidence, he thought, was due to the fact that in many island communities the family intermarries to the extent that the community is mainly one family.

These two instances of active research under progress are only a small part of the total picture of research under way over the country. Financial backing, coordination of projects, consultation, advice—are all available through the Foundation, and help to keep the program stimulated and supported, to hasten the day when we shall not only know the cause of infantile paralysis, but be able to do something about preventing it on a large scale. For now, each year brings increased numbers of persons to be cared for. It is estimated that at least 17,000 cases this year (1949) will need to be cared for in 1950. This cost alone will be over $20,000,000. No prediction can be made for the number of new cases in 1950 which will require care.

If the time ever comes when there will be a "preventative" for the disease, we shall still need to have continual emphasis and education to teach people to avail themselves of the medical assistance leading to better health protection. Education for better health can never stop—we have only to look at the comparatively recent smallpox scare in New York City, and count the hordes of persons who came out for vaccination to avail themselves of last minute protection. It took a very active and positive fright to get them to take advantage of an available resource that we have attempted to educate them to use for years.

Also, so far this year (1949) to October 1st, there have been over 5,000 cases of diphtheria in the United States. Yet TAT and toxoid have been available for two decades. The story will be the same with infantile paralysis, even when a "preventative" is found.

How can teachers—particularly science teachers— help in a health program concerned with infantile paralysis? There are four main ways:

1. By being certain that accurate information regarding poliomyelitis—or any other disease—is provided and discussed. This will, in turn, help in reducing fear about polio—or any other disease. As we learn facts concerning the spread of the disease, and practice them, incidence rates may retract.
2. By continually giving emphasis to health and the diseases which undermine it. A week's project is not the answer. Definite time provided for detailed study is important, but it is the everyday admonishment —when needed—that will help to change health habits.
3. By the teacher—herself or himself—*practicing health habits*. A teacher should be an example—not the exception—to the rule.
4. By specifically aiding those students returning to school who have had the disease. They need continual assurance, they need continual adjustment both to their school and to their classmates and teachers. It is one time that teamwork and planned cooperation are needed between faculty members, between the school and the home, and between the school and the student.

Firearms Education for the Biology Class

GUY P. FRANCK
College of Education, University of Wyoming, Laramie, Wyoming

The biology class at the University High School has recently completed a two-weeks' study of a unit in wildlife conservation. All types of wildlife were considered during the first part of this study. However, from the very beginning it was apparent that the interest of the pupils was directed toward the different kinds of wildlife found in Wyoming. The teacher made no attempt to discourage this interest because here is a live subject which these future citizens of Wyoming will enjoy in the years to come when many problems of this wildlife will be theirs to solve.

The relationships of wildlife to soil, vegetation, and water were studied and discussed. The economic and aesthetic values of wildlife were considered. National, state, and local conservation agencies, game laws, good sportsmanship, clean farming, forest protection, stream pollution, reasons for the decline of wildlife, hunting, firearms, and many other topics of interest found a place in this biology classroom. Some of these topics were not found in the biology textbook used in the class.

The teacher in charge of this unit in conservation was a student teacher who had taken several courses in wildlife and conservation. The responsibility of the author was to supervise this teaching. The interest and understanding developed by this student teacher will remain with his pupils for many years to come.

One day after class, during which firearms and hunting had been discussed, he asked whether it was permissible to bring some guns to class for the purpose of instruction. This permission was granted after objectives and plans had been discussed. The objectives set up were:

1. To develop an understanding of the fundamentals of firearms construction, maintenance, and function.
2. To provide an understanding of ballistics.
3. To instill the concepts of safety in firearms-handling and operation.

A local sporting-goods store gladly permitted the school to borrow a revolver, pistol, shotgun, .22 and 30-06 caliber rifles, plus a complete set of cartridge-loading equipment and supplies.

The following are some of the activities and topics considered during the period of instruction:

1. A study of a diagram of a typical rifle
2. A discussion of how gun parts are made
3. Pressure points in a gun
4. How properly to clean a gun so as to remove moisture, fouling, powder, and primer corrosion
5. Proper care of a gun at home and in the field
6. How revolvers, pistols, shotguns, and rifles function, and their limitations and capabilities
7. A study of a diagram of a typical cartridge and projectile
8. How cartridges are made and loaded
9. Demonstration of the loading of a cartridge
10. Muzzle velocity
11. Trajectory, line of sight, point of impact, etc.
12. Gun and ammunition defects
13. Operation precautions

14. Basic safety rules for handling all firearms in the home and in the field.

During the teaching and whenever possible, the discussion was supplemented by demonstrations with actual firearms, ammunition and loading equipment, or with explanations of chalk diagrams placed on the blackboard. Finally, all pupils were allowed to handle the guns so that each could learn how they operate. When the study had been completed, many of the pupils expressed their regret for the termination of such a worthwhile and interesting subject.

One might now ask this question: Does firearms-education have a place in the schools? Just ask the tenth-grade biology pupils in the University High School and you will receive an affirmative answer. It seems logical for schools to offer this type of instruction. One only has to check the roll of accidental fatalities in the home and during the hunting seasons to be convinced that such instruction should be offered somewhere along the line. Teachers of natural science have an opportunity to offer this instruction in their courses. This type of instruction should be offered especially in all states that permit game hunting. Why not teach these young people to understand and do safely the things that they are doing now and doing in later life? The high schools can do it if they will.

AMERICAN YOUTH HOSTELS

American teachers who look forward to traveling during their summer vacations, or who want to interest their students in travel, can choose from a wide variety of low-cost hosteling trips scheduled by *American Youth Hostels*, 6 East 39th Street, New York City. In addition to 27 trips in this country and abroad, hundreds of shorter trips are planned by AYH Local Councils throughout the United States, many of which will cost as little as $1.25 a day.

Hosteling—inexpensive hiking or cycling along established routes with overnight stays in hostels maintained by Local Councils of interested citizens—has long been a popular mode of travel for young people abroad, and is attracting many followers in this country. In addition to its recreational value, many educators believe that hosteling can be an excellent supplement to a school curriculum.

Trips sponsored by the AYH National Headquarters will range in length from five to ten weeks and will start in late June and early July. On these trips, hostelers will travel in small mixed groups with trained leaders. Estimated costs range from $115 for some trips in the United States to $780 for trips to North Sea and Mediterranean areas. In all cases costs cover the entire trip from starting to finishing points. For overseas trips this means embarkation and debarkation points.

In the United States, hosteling groups will visit northern New England, the Great Lakes, Long Island Sound and the Colonial Virginia area. Of particular interest are the seven-week National Parks–High Sierras trip for hikers and the Rolling Hostel trip, in which estpecially equipped trains will take hostelers cross country, permitting them to cycle in scenic areas, using the train as their Hostel each night. Rolling Hostel trips will go to the Grand Canyon and Yellowstone Park.

Trips planned for the North American continent will take hostelers to the Canadian Rockies, Gaspe Peninsula, Ontario, the Maritime Provinces and the Saguenay River area, all in Canada, and to Mexico, Guatemala and Alaska.

Hosteling in the United States began in 1934 and has since spread from coast to coast. At present there are AYH Local Councils in 29 states, which supervise 160 hostels in such parts of the country as the New England coastal and Mountain areas, Long Island Sound, the Great Lakes, Colonial Virginia and the mountain regions of the West. Trips sponsored by these Councils vary in length, but their costs are uniformly low. Details of itineraries and costs of trips are available on inquiry at AYH National Headquarters, 6 East 39th Street, New York 16, N. Y.

BIOLOGY LABORATORIES

By The "Old Fossil"

LOCATING A SPECIFIC FOCAL AREA on a slide is difficult for a beginner if he does not know what to look for. The instructor can aid this situation if he blackens out all but the specific focal area of the coverslip with asphalt paint. He does this while the slide is clipped on the stage and in focus. *Educational Focus* for February 1949 had an article on this topic.

NEW FILM HUMAN GROWTH 16 mm color sound may be purchased from the E. C. Brown Trust of University of Oregon or rented. It is an animated drawing series on "the facts of life." It is suitable for the early adolescent. Another film by McGraw-Hill titled "Human Reproduction" is a text-film. It is more advanced than the Oregon film.

OUR GARDEN POOLS were plagued with an excessive growth of algae. Perhaps your aquaria are the same. We use one part of copper sulfate to a million of water. If at the end of a week it does not clear repeat the process. Do not make it five parts or you will kill fish life as well. Measure your tank. 231 cubic inches to gallon, eight pounds to gallon. Figure the weight of the water and add one millionth of this weight of copper sulfate. If you do not have accurate scales weigh out an ounce of the salt and dissolve in three quarts of water. This is about one part in a hundred. Take the proper fraction of this solution to get the proportions. If you are lost at this point send me your tank dimensions and I will make up enough solution for you. Send a quarter for package and postage.

NEW DIRECTIONS IN SCIENCE TEACHING is a book by Laton and Powers; publishers McGraw-Hill 1949. A number of trends in biology laboratory teaching is presented as it covers the entire natural science field.

OUR GREENHOUSE SEED BILL varies from twenty to fifty dollars per year. We buy from reliable seed houses. This is important because there are no flower seed laws to back you up. New York state is the exception. Vegetable seeds are inspected and regulated both by states and the federal government laws.

A SKULL WAS FOUND in a cave twenty miles from Peking, China in 1929. This human remnant was deposited thru default by its original owner some half million years ago. A few days before Pearl Harbor it was packed in a trunk and entrusted to the Marines. They were being evacuated. Japanese soldiers probably did not realize the importance of the trunk and its content when it was seized. What happened to it no one has been able to trace. Only casts of the original remain. Casts can never take the place of the original Peking skull and teeth which were lost.

SEED TREATMENT. We grow several hundred seedlings and flowers and vegetables each spring. Cabbage and tomato plants should be hot water treated by the seed firm before sale. It is not a good idea to purchase disease resistant varieties unless you know definitely that your soil is infected. Disease resistant plant varieties often lack many of the desirable characters. They may possess weak stems, be off color in flower or food flavor. Seeds of the beautiful lupine flower must be cracked before planting.

REPRINTS mentioned in the December 1949 issue have been mailed to all requests. There were over half a hundred sent out. Since there was such manifest interest in the greenhouse we will continue to include notations about it.

WE HAVE A FORMAL GARDEN in the enclosed court of the school. In this are two circular pools sixteen feet in diameter and a rectangular one fifty feet long. To prevent freezing expansion they are drained each fall. Storage of the goldfish and others has been a problem. We tried many methods over the years. Last fall we purchased three large farm stock watering tanks. They were placed in the greenhouse. An automatic air compressor of the filling station type was purchased. A regulating pressure valve was placed on the tank and leading from this was a quarter inch pipe. Extending into each

tank were two nozzles serving as aerators for the water. These are successfully supporting the goldfish and all aquatics from the outside pools many times the tanks' capacity.

TRANSPOSITION. In the December 1949 issue two items were transposed. One should follow the other. "Aardvark—Three artists could not draw" should have been followed by "Such is proof positive that we need laboratories for the study of biology and things biological."

DO YOU USE DDT around pets in your laboratory, animal cages, or livestock at home? It can be purchased in handy bombs. Remember however with animals it is a toxic cumulative poison and should be used according to directions. Consult your Agricultural Experimental Station for its extensive usage. Some of the newer insecticides which have been developed but less widely studied and used are ABH, BHC, DDD, GBH, and HEPT. Just because these are newer does not indicate any one is better than DDT. They must stand the tests of experimentation and usage.

HOW OTHERS LIVE. Had a thank you letter from a 67 year old retired German school teacher. For two years I sent him garden seeds thru his relative and my friend. Due to the blockade, last year seeds will be planted this summer. His pension is meager and food supply must be supplemented from a garden. They need household necessities, clothing, food, seeds. Would be glad to give you the address.

TO A HIGH SCHOOL BOY by J. C. Warner, Dean of Graduate Studies, Carnegie Institute of Technology, has an interesting article in *The Educational Focus,* February 1950. It is well worth the secondary school students' time to read. It is a sermon packed full of functional vitality. This issue has other especially good articles. It is free. Write to B & L. Rochester 2.

PRESERVED MATERIAL, either plant or animal must be immersed in the preserving fluid at all times except for the handling periods. Once the preservative has escaped from the tissues it will not reabsorb into them again. When materials are left from one semester to another be sure to check their levels to find out whether the fluid is well above the top of all parts of the specimens. Volatile materials as alcohol will escape from an apparently closely fitting jar lid. Often the metallic lid rusts and corrodes leaving holes in it. Specimens can be ruined when these conditions develop. Always use glass containers whenever possible.

STORAGE JARS. It is best to keep a few extra storage jars on hand. These may be obtained from the school lunch room. They purchase relish, mustard, salad dressing and pickles in gallon glass jars. These have three inch screw tops. Appoint a student to contact the manager of the lunch room and secure these for you. Do not remove the lid paper liners. The liners form the seal.

INSPECT ALL SUPPLIES when received. Check them against the shipping memo for quantity and correctness of item. If there is any discrepancy notify the firm immediately about the mistake. It is your duty if you do return materials to specify exactly why it is returned. The expressions "unsatisfactory," or "not suitable for my use" are not sufficient. State specifically what is unsatisfactory about it or why you can not use it.

BOOKS FOR STUDENTS. *Adventures With Animals and Plants,* Heath; *Exploring Biology,* Harcourt Brace; *Vison, the Mink,* E. P. Dutton & Co.; *Teen-Age Animal Stories,* Lantern Press; *Plant Families — How to Know Them,* William C. Brown Co.; *Bob Vincent, Veterinarian,* Dutton. All are 1948 or 1949 Copyrights. For the teacher, *Audio-Visual Materials of Instruction* 1949 NSSE University of Chicago Press.

HOW TO STUDY is a ten page booklet published by Northwestern University. If any one wants to borrow it they may have it for a month. In the fall I start my classes the first week with the initial day devoted to registration, orientation and adjustment. The second day is devoted to HOW TO STUDY. The third day is devoted to HOW TO SUCCEED IN THE STUDY OF BIOLOGY. In the latter there are thirteen points. These include biology, a new language—museums, parks, zoos, visit them often

—be interested in many phases of biology—take frequent hikes—buy cheap indentification guides—start a Nature Scrap Book—ask questions — collect specimens — read — write for free literature—join clubs—become interested in conservation—make a hobby of biology. I am sure you can add new twists to these or extend the list to a greater length by going more into detail.

CHICAGO TEACHERS COLLEGE is offering a Saturday Field Trip course in biology and giving regular college credit. It is sponsored by Dr. E. C. Colin of the college and Dr. David Thompson of the Cook County Forest Preserve District. The general areas of study are: the prairie, fruit and seeds, aquatic biology, forestry, fossils, and aquatic birds. Dr. Colin has been on the editorial staff of *THE AMERICAN BIOLOGY TEACHER* for a number of years and was at one time its Managing Editor. Dave Thompson was active during the war having field trip schools for elementary pupils. If the response of Chicago teachers is extensive there is the possibility of establishing a Cook County Teachers Field Station in the forest preserves as a residence institution. It would then be possible for the students to spend an entire summer session in the woods.

FREE FILMS. Department of Public Relations, General Motors Corporation, 1775 Broadway, New York 19, N.Y. They issue films. One that is mildly biological is "King Cotton," 16 mm, 18 minutes. If you write them they may have others of interest in their catalogue. You pay the transportation charges one way.

NEA TOURS. These tours cover most of the continent and adjacent areas. If interested write Division of Travel Service, NEA Headquarters, 1201 Sixteenth Street N. W., Washington D. C. Mid June to Labor Day.

HAS TEACHING of introductory and secondary school biology crystallized sufficiently during the past three decades to develop a philosophy of biology teaching with its own distinctive character and yet remain an integral part of the philosophy of education?—Is there one key word which can caption this philosophy of biology teaching? If your answer is positive to both questions or you are at least open minded to the fact that they might be positive then:—How can this philosophy of biology teaching (your teaching philosophy) cause biology to be one of the important integrating forces in education, draw out the creative self in students to its maximum potential, and develop those desirable democratic values necessary for constructive world progress thru this second half of the century? Think it over. I will be back. If you have ideas write them to "The Old Fossil," 5061 N. St. Louis Avenue, Chicago 25, Illinois.

Reviews

GRAVES, ARTHUR H., AND RUSK, HESTER M. *Guide to Trees and Shrubs*. Fourth Printing. Published by the authors, Brooklyn, N. Y. xii + 76 pp. illus. 1949. $1.

This guide, with its excellent key, is an outgrowth of mimeographed outlines which for eight years were distributed to members of the tree and shrub classes at the Brooklyn Botanic Garden. Its use through three printings made evident the fact that the book's usefulness is by no means limited to the New York area. It has been used as far north as Maine and Ontario, as far west as Minnesota and as far south as Virginia.

Although there are many books on trees and shrubs, there are few that deal so extensively with both the winter and summer characters of woody plants. Not many books include both the trees and shrubs and very rarely are the commoner exotic and foreign species included. This makes the GUIDE of particular value to those who live in large cities because so often in parks and gardens the exotic species are as common as the native ones.

Although originally designed for class use, the key is so usable, hundreds are teaching themselves with it. However, it should be pointed out that it is not a child's book and not a picture book, but it can be used successfully by those interested in the landscape.

Hartford Public High School,
PHILIP E. FOSS,
Hartford, Connecticut

McCay, Clive M. *Nutrition of the Dog.* Second ed. Comstock Publishing Co., Ithaca, N. Y. x + 337 pp. illus. 1949. $3.50.

This book is designed for those who have a scientific interest in the feeding and care of dogs. Only information supported by evidence gained from carefully conducted and recorded experiments is included.

Each chapter is arranged so that essential, applied knowledge is presented first. Later, the material becomes more technical and finally, for veterinarians and scientists generally, there is a bibliography.

The American desire for pets can now be better satisfied than in the more recent past. For one thing, families are moving to the edge of cities where there is more room. War experiences have indicated the greater possibilities of dog training. Consequently, as the population becomes older, the need so often felt by the old for the companionship of dogs can be better realized. Therefore, a book with accurate information concerning the nutrition and care of the dog can easily become one of the more valuable of the household books.

Philip E. Foss,
Hartford Public High School,
Hartford, Connecticut

Oosting, Henry J. *The Study of Plant Communities.* W. H. Freeman and Company, San Francisco. 389 pp. illus. 1948. $4.50.

The book is an interesting, readable introduction into plant ecology in which no attempt is made to summarize known information fully. Logical arrangement and completeness of basic material, however, make a textbook of wide usefulness on the college level. Conflicts in terms and ideas are developed into workable conclusions, and challenging problems are made evident. The high school teacher with limited knowledge of ecology will enjoy reading many chapters and will gain numerous interesting ideas for science teaching.

Briefly, the areas covered are the nature of the community, the quantitative and qualitative methods of vegetative analysis, physical and biological factors controlling the community, the present distribution and dynamics of communities in North America, and applied ecology as it relates to various phases of agriculture and to man. There are 276 particularly well-chosen references at the end of the book. General references are also given at the end of each chapter.

The typography and format are excellent, and the binding of the book is durable. The number of half tones and the number of line drawings are in good proportion for the kind of book.

Robert C. McCafferty,
Central High School,
Wadsworth, Ohio

M. W. de Laubenfels. *Life Science.* Fourth ed. Prentice Hall Inc., 70 Fifth Ave., New York 11. vi, 407 pp. figs. 1024. 1949. $5.75.

Life Science is a welcome contribution to the science of biology. The treatment is original, interesting, and different. In reading the book you gain the impression that the author is talking to you directly. The excellent illustrations and numerous drawings are more than adequate and are one of the features of this book. The page size, 8 × 11, enables the author to present many photographs which would not be possible with a smaller size page.

The book is made up of 28 chapters incorporated into five major parts—General Biology, Human Biology, Plant Biology, Animal Biology, and Social Biology. The enumeration of the key word designating the title of each chapter will emphasize the comprehensive coverage of this book: biology, biophysics, biochemistry, cytology, embryology, histology, anatomy, physiology, psychology, hygiene, immunology, dietics, botany, phytophysiology, taxonomy, agriculture, bacteriology, zoology, oceanography, parasitology, entomology, zoogeography, ecology, genetics, eugenics, paleontology, anthropology, and philosophy.

Life Science is a stimulating book and one which can be read with interest and understanding by the layman. Since it has many interesting facts, experiences, and observa-

tions which give the reader a compelling story of the living world, it is an excellent reference for high school students.

MELVIN A. HINTZ
South Milwaukee High School,
South Milwaukee, Wisconsin

EMERSON, FRED W. and SHIELDS, LORA MANGUM. *Laboratory and Field Exercises in Botany.* The Blakiston Co., Philadelphia, Pa. 303 pp. 34 plates, 2 figures. 1949. $2.50.

This is a well written and thoroughly comprehensive laboratory teaching aid for elementary botany at the college level. It combines some of the best features of a laboratory manual with those of a laboratory workbook.

The authors have used a judicious amount of space to cover the physiological and ecological aspects of the subject, which should help the teacher to offer a dynamic course in general botany. To aid the student, a brief outline of the subject matter to be covered is given at the beginning of each exercise. The authors take into account

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individual differences among the students and have included extra activities marked with an asterisk for those students who may excell the average student. To aid the teacher, a list of materials to be used is given at the beginning of each exercise. Also particularly useful to the teacher is the preparation and supply schedule and the lists of supplies, equipment, and formulas which are given at the end of the book for use during the entire course.

The book is written primarily to accompany Emerson's *Basic Botany*, however, in the opinion of the reviewer it could easily be adapted for use with any of the texts available for use in general botany.

Addison Lee,
Department of Botany,
University of Texas,
Austin, Texas